wood.

Technical Memorandum

Registered Professional Engineer (Civil) CERTIFICATE NO. 58253 HAIMING YUAN Date Signed 9/19/22 ARIZONA, U.S.A. Expires: 9/30/2023

To: Javier Toro

From: Wood Environmental and Infrastructure Solutions, Inc. (Wood)

Date: September 19, 2022

Ref: Copper World Project – Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Executive Summary

This technical memorandum was prepared by Wood Environment & Infrastructure Solutions, Inc. (Wood) to document the results of a series of stability analyses conducted to assess the slope stability of Primary Settling Pond, Process Area Stormwater Pond, Reclaim Pond, and Raffinate Pond. Two-dimensional (2D) limit equilibrium analyses were performed using Slide2 version 9.02 software (Rocscience, 2021) on three critical cross sections of the ponds. Stability analyses were performed following the same methodology and utilizing the same materials and model properties as previous stability analyses performed on the Tailings Storage Facilities (TSF), Waste Rock Facility, and Heap Leach Facility. Global minimum factor of safety (FoS) was calculated for static loading condition as well as pseudo-static loading condition. Results indicated that the FoS meet or exceed the selected acceptance criteria defined by the Arizona Department of Environmental Quality (ADEQ) Best Available Demonstrated Control Technology (BADCT) manual (ADEQ, 2004) for all cross sections evaluated.

1 Introduction

Wood is providing engineering support for the Aquifer Protection Permit (APP) Application for the Copper World Project. The proposed project will be an open-pit copper mine with associated infrastructure facilities (i.e., heap leach, waste rock dumps, conventional tailings storage facility, auxiliary facilities, etc.) situated within the Santa Rita Mountains in Pima County, Arizona. The heap leach grading plan (prefeasibility study [PFS]-level) is shown in Figure A1 of Attachment 1. This grading plan includes layout of Primary Settling Pond, Process Area Stormwater Pond, Reclaim Pond, and Raffinate Pond.

Stability analyses in this project were performed utilizing three critical cross sections, herein referred to as S1, S2, and S3. Figure A2 and Figure A3 of Attachment 1 show the layout of the ponds along with the approximate location of these three cross sections. According to Figure A2 and Figure A3, the Primary Settling Pond has a slope of 3H:1V (horizontal to vertical ratio) and all other ponds have a slope of 2.5H:1V. All ponds will be lined with composite liner systems.

2 Stability Analyses

2.1. Models and Material properties

Schematics of Slide2 models, created for stability analyses, are shown in Figure 1. Process Area Stormwater Pond (cross section S1) as well as Reclaim and Raffinate Ponds (cross section S2) will be constructed via excavating waste rock and native foundation soil. For these ponds, stability analyses were performed on interior slopes of the ponds. Primary Settling Pond (cross section S3) will be constructed by excavation of Native Foundation Soil and placement of Embankment Fill Material. Stability analyses on Primary Settling Pond was also performed for the interior slopes of the pond. The reason is the interior and exterior slopes have the same slopes (i.e. 3H:1V) and comparable height (Figure 1).

Material properties utilized in stability analyses were adopted from the previous stability analyses memorandums for Heap Leach, Waste Rock Facility, and Tailings Storage Facility (Wood, 2021a; Wood, 2022a & b). According to these memorandums, native foundation soil, waste rock, and embankment fill are expected to have drained behavior during the shear (i.e., no excess pore water pressure during loading) considering their gradation and their USCS (Unified Soil Classification System) description. Therefore, only drained (i.e., effective-stress) stability analysis was performed in this study. The summary of material properties is tabulated in Table 1.

In these models, groundwater table has not been considered as it is beyond influence depths for stability evaluation in accordance with Wood (2021b).

Table 1. Summary of material properties for slope stability analyses

Material	Unit Weight (pcf)	Effective-stress Friction Angle, f′ (°)	Effective-stress Cohesion, C′ (psf)
Foundation	125	36	0
Embankment Fill	125	36	0
Waste Rock	125	37	0

2.2. Methodology

Two-dimensional limit equilibrium analyses were performed using the software Slide2 to evaluate the stability of ponds in each cross section. Slide2 is capable of performing various limit equilibrium analyses such as Simplified Bishop method, Spencer's method, Morgenstern-Price method, and several others (Rocscience 2021).

Stability analyses of this project were performed assuming ponds in dry condition. The reasons are:

- Ponds are lined with a composite liner system. Assuming the integrity of liner system, phreatic surface cannot be developed within the embankment and native ground even when the ponds are filled with stormwater or process solution.
- It is conservative to model slope stability of lined ponds without any stored liquids in them since the stored liquid will act as a buttress for slopes, oppose the slope failure mechanism, and enhance the overall stability of slopes.

For this project, Spencer's methods (Spencer, 1967) was used, which is a method of slices (consideration of potential failure masses as rigid bodies divided into adjacent regions or "slices," separated by vertical boundary planes) that satisfies both moment and force equilibrium. In this method, the shear strengths that would be required to just maintain equilibrium along the selected failure plane is calculated, and then the safety factor is determined by dividing the available shear strength by the equilibrium shear stress. Consequently, calculated safety factors indicate the percentage by which the available shear strength exceeds, or falls short of, that required to maintain equilibrium. Safety factors, obtained from stability analyses, in excess of 1.0 indicate a stable slope and those less than 1.0 indicate instability. The greater the mathematical difference between a safety factor greater than 1.0 and 1.0, the larger the margin of safety. For safety factors less than 1.0, the difference indicates the margin of instability.

Stability analyses in this study were performed considering both static and pseudo-static loading conditions to determine critical failure surfaces and their corresponding factors of safety for all slopes of the ponds. Pseudo-static-based analyses are commonly used to apply equivalent seismic loading on earth fill structures as a screening tool. In an actual seismic event, the peak acceleration would be sustained for only a fraction of a second. Actual seismic time histories are characterized by multiple-frequency attenuating motions. The accelerations produced by seismic events rapidly reverse motion and generally tend to build to a peak acceleration that quickly decays to lesser accelerations. Consequently, the duration that a mass is subjected to a unidirectional, peak seismic acceleration is finite, rather than infinite. The pseudo-static analyses conservatively model seismic events as constant acceleration and direction (i.e., an infinitely long pulse).

Therefore, it is customary for geotechnical engineers to take only a fraction of the predicted peak maximum site acceleration when modeling seismic events using pseudo-static analyses (Hynes-Griffin and Franklin, 1984). In this project, a pseudo-static coefficient of 0.04g, which is 1/2 of the design Peak Ground Acceleration (PGA) of 0.07g (corresponding to the 2,475-year return period), was adopted from previous slope stability memorandum (Wood, 2021a; Wood, 2022a&b).

Stability analyses were performed for circular, non-circular, and composite surfaces. Several search routines were used to locate the failure surface with the lowest FoS. These methods provide powerful algorithms in which the search for the lowest safety factor is refined as the analysis progresses. An iterative approach is used, so that the results of one iteration are used to narrow the search area on the slope in the next iteration. The auto-refine search routine was shown to consistently locate the failure surface having the lowest FoS, defined as the critical failure surface.

Overall, stability analyses in this project are comparable to previous stability analyses on Heap Leach Facility, Waste Rock Facility, and Tailings Storage Facilities in terms of methodology and material properties.

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36

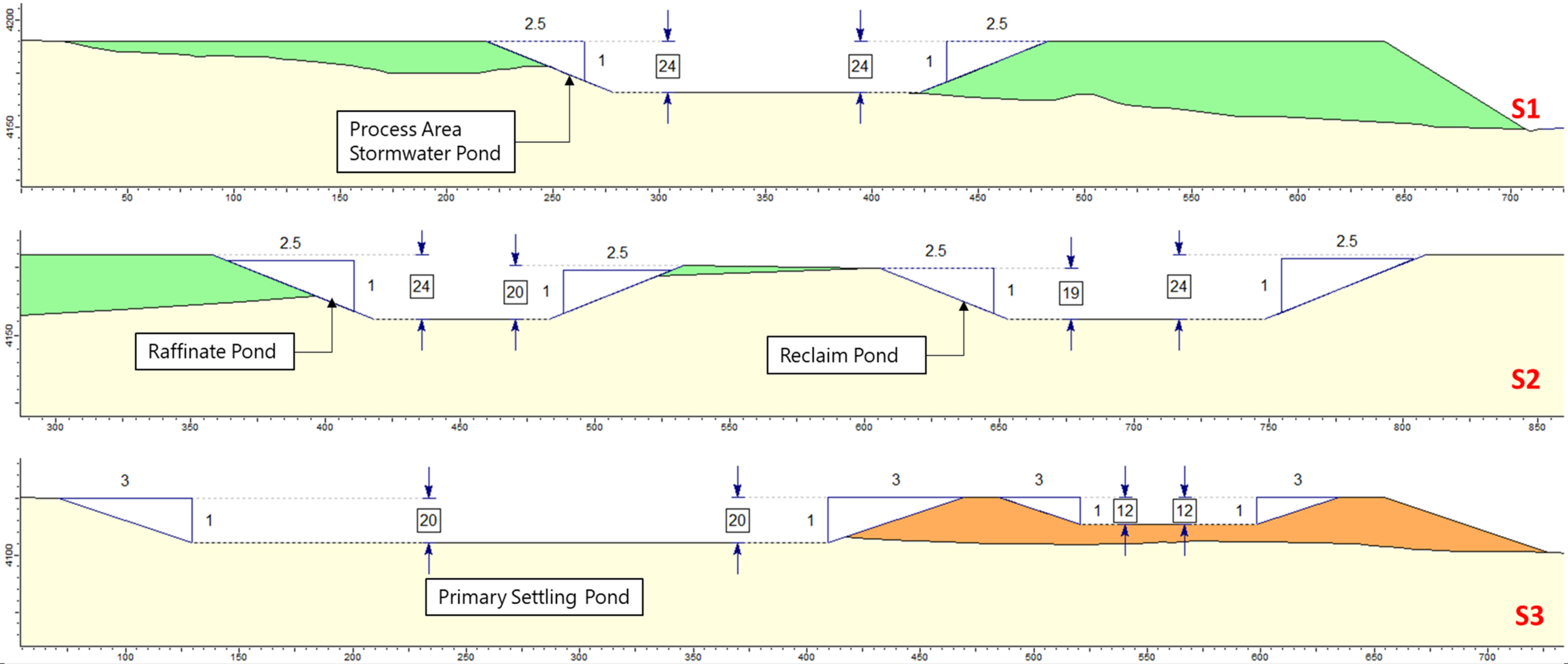

Figure 1. Schematics of Slide2 models of cross sections S1, S2, and S3

2.3. Results

Results of slope stability analyses are shown in Attachment 2. Figures B1 to B16 of Attachment 2 show critical failure surfaces and their corresponding FoS for cross sections S1 to S3 under various analysis scenarios. FoS values resulted from the analyses are also tabulated in Table 2. In this table, the minimum recommended factors of safety according to BADCT (ADEQ, 2004) for static and pseudo-static analyses are also included for comparison. According to Table 2, the FoS values meet or exceed the BADCT criteria for slope stability.

Table 2. Global minimum factor of safety (FoS) from stability analyses

<table>
<tr><th rowspan="3">Facility</th><th rowspan="3">Cross Section</th><th colspan="3">Static Analyses</th><th colspan="3">Pseudo-Static Analyses</th></tr>
<tr><th colspan="2">Failure Direction</th><th rowspan="2">Min BADCT Requirement</th><th colspan="2">Failure Direction</th><th rowspan="2">Min BADCT Requirement</th></tr>
<tr><th>West-East</th><th>East-West</th><th>West-East</th><th>East-West</th></tr>
<tr><td>Process Area Stormwater Pond</td><td>S1</td><td>1.9</td><td>1.8</td><td rowspan="4">1.3</td><td>1.7</td><td>1.6</td><td rowspan="4">1.0</td></tr>
<tr><td>Reclaim Pond</td><td>S2</td><td>1.8</td><td>1.8</td><td>1.6</td><td>1.6</td></tr>
<tr><td>Raffinate Pond</td><td>S2</td><td>1.9</td><td>1.8</td><td>1.7</td><td>1.6</td></tr>
<tr><td>Primary Settling Pond</td><td>S3</td><td>2.2</td><td>2.2</td><td>1.9</td><td>1.9</td></tr>
</table>

3 Summary

A series of slope stability analyses were performed using the software Slide2 (version 9.02) on three cross sections, intersecting the Primary Settling Pond, Process Area Stormwater Pond, Reclaim Pond, and Raffinate Pond. Stability analyses were performed following the same methodology and utilizing the same materials and model properties as previous stability analyses performed on the Tailings Storage Facilities (TSF), Waste Rock Facility, and Heap Leach Facility. Analyses were performed under both static and pseudo-static loading scenarios on different ponds slopes. The result of the stability analyses indicated that the global minimum factor of safety meet or exceed the BADCT criteria for slope stability under static loading and pseudo-static loading condition.

4 References

Arizona Department of Environmental Quality [ADEQ], (2004). Arizona Mining BADCT Guidance Manual. Phoenix, Arizona.

Hynes-Griffin, M. E., & Franklin, A. G. (1984). Rationalizing the seismic coefficient method. Army Engineer Waterways Experiment Station Vicksburg Ms Geotechnical Lab.

Morgenstern, N. R. and Price, V. E. (1967). The Analysis of the Stability of General Slip Surfaces. Geotechnique, Vol. 15, No. 1 pp. 77-93

Rocscience (2021). SLIDE2, 2D limit equilibrium slope stability for soil and rock slopes. 2021 Rocscience Inc, Slope Stability Verification Manual, Toronto, Canada

Spencer, E. (1967). A Method of Analysis of the Stability of Embankments Assuming Parallel Interslice Forces. Geotechnique, London

Wood (2021a). Stability Analysis Memorandum, Waste Rock Facility. Prepared for Rosemont Copper Company by Wood, November 29, 2022.

Wood (2021b). Geotechnical Site Investigation Memorandum, Heap Leach, Tailings and Waste Rock Facilities, Rosemont Copper World Project, prepared for Rosemont Copper Company, by Wood, December 1.

Wood (2022a). Stability Analysis Memorandum, Tailings Storage Facility. Prepared for Rosemont Copper Company by Wood, January 14, 2022.

Wood (2022b). Stability Analysis Memorandum, Heap Leach Facility (HLF). Prepared for Rosemont Copper Company by Wood, March 24, 2022.

Attachment 1: Grading Plan and Ponds Layout

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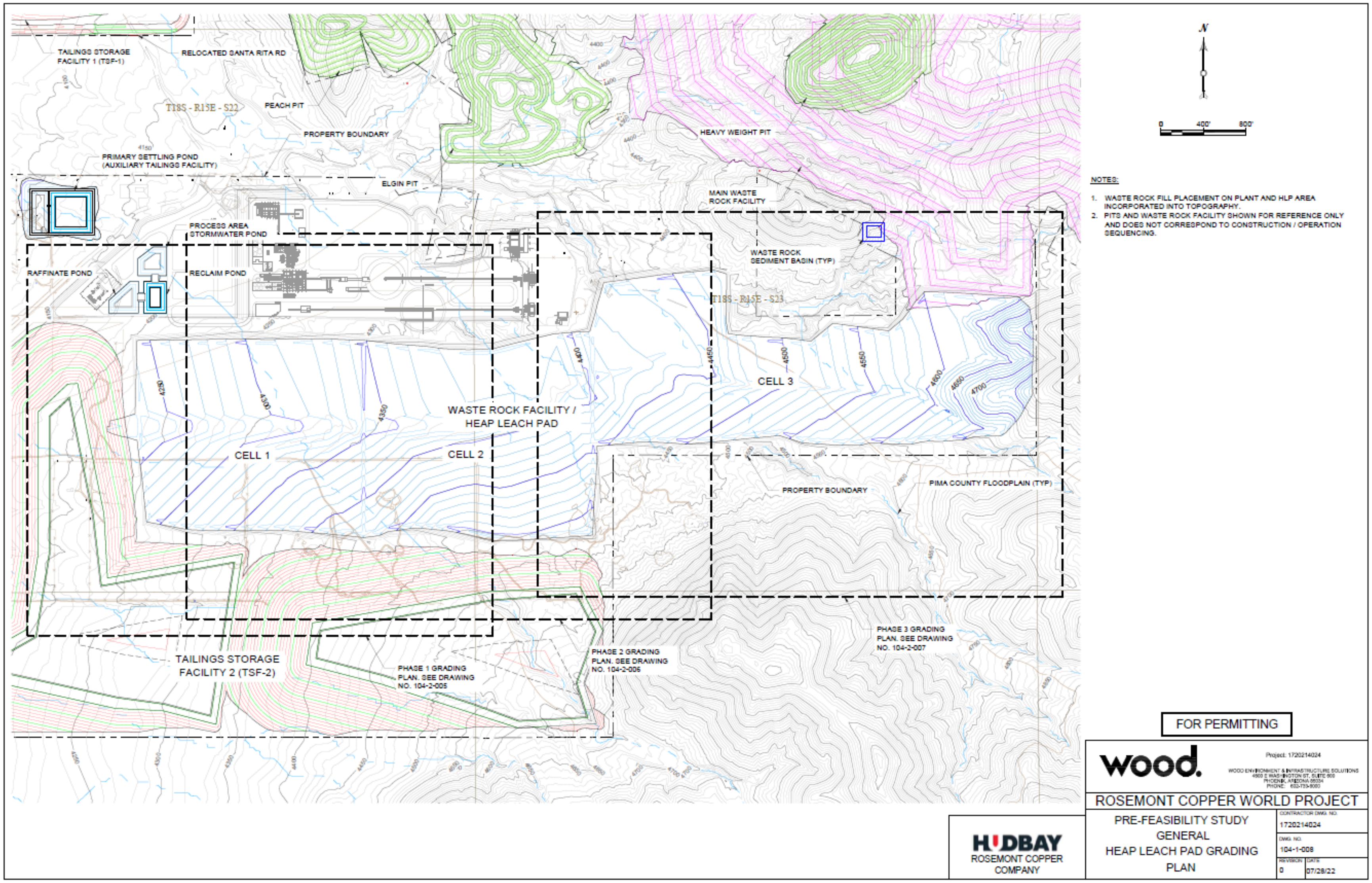


Figure A1. General Heap Leach Pad Grading Plan showing the location of different ponds

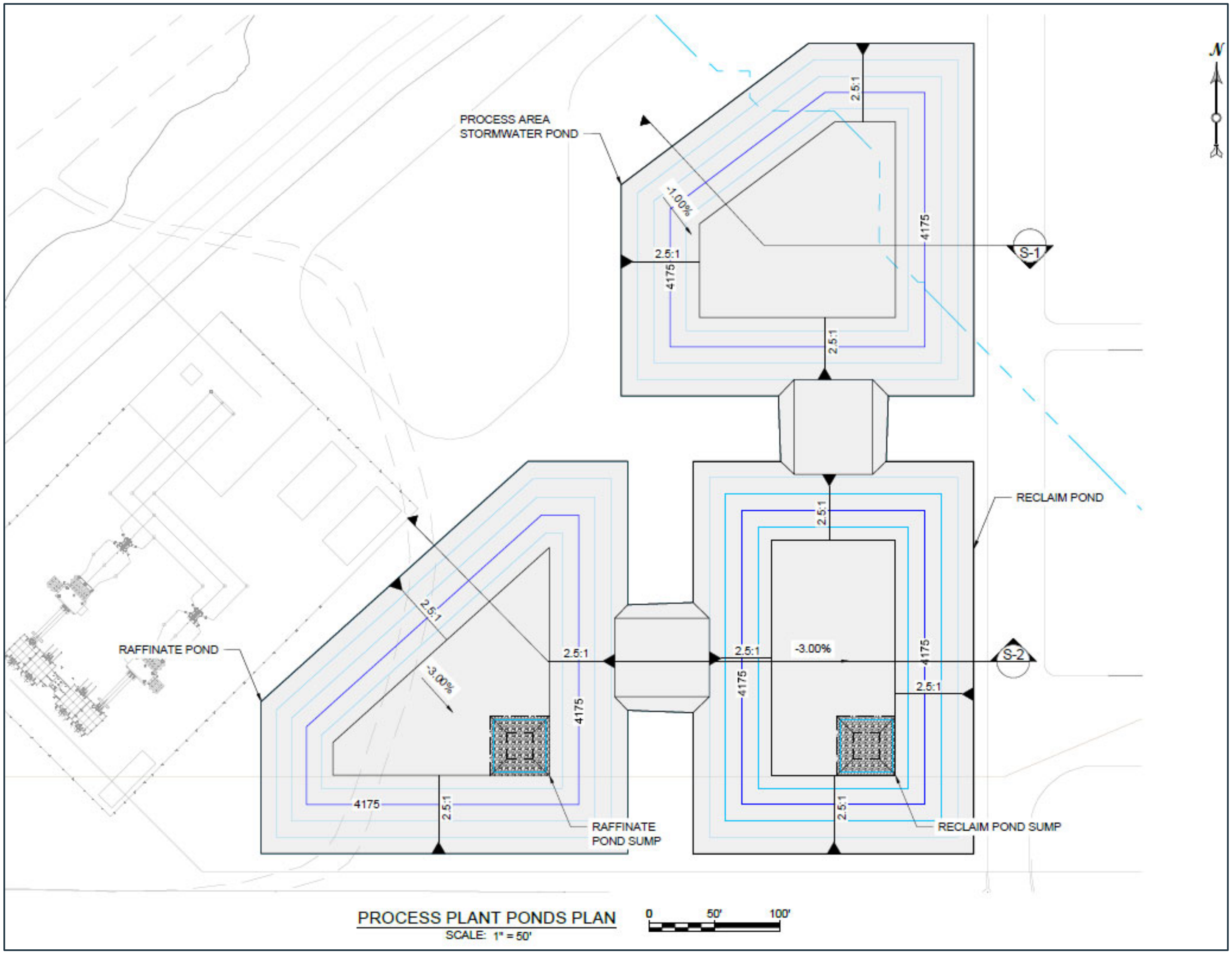


Figure A2. Location of cross sections S1 and S2 within Process Area Stormwater Pond, Reclaim Pond, and Raffinate Pond

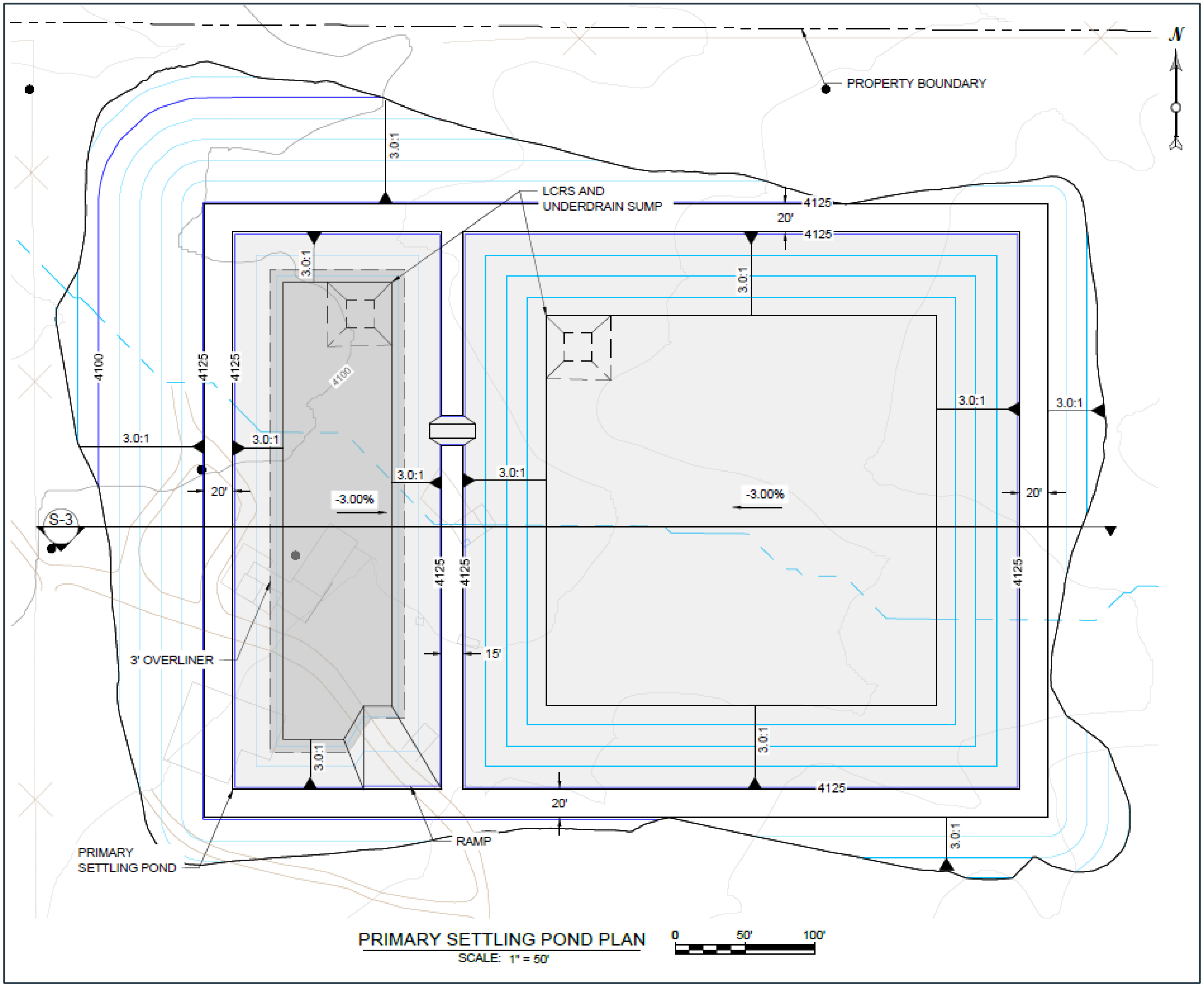
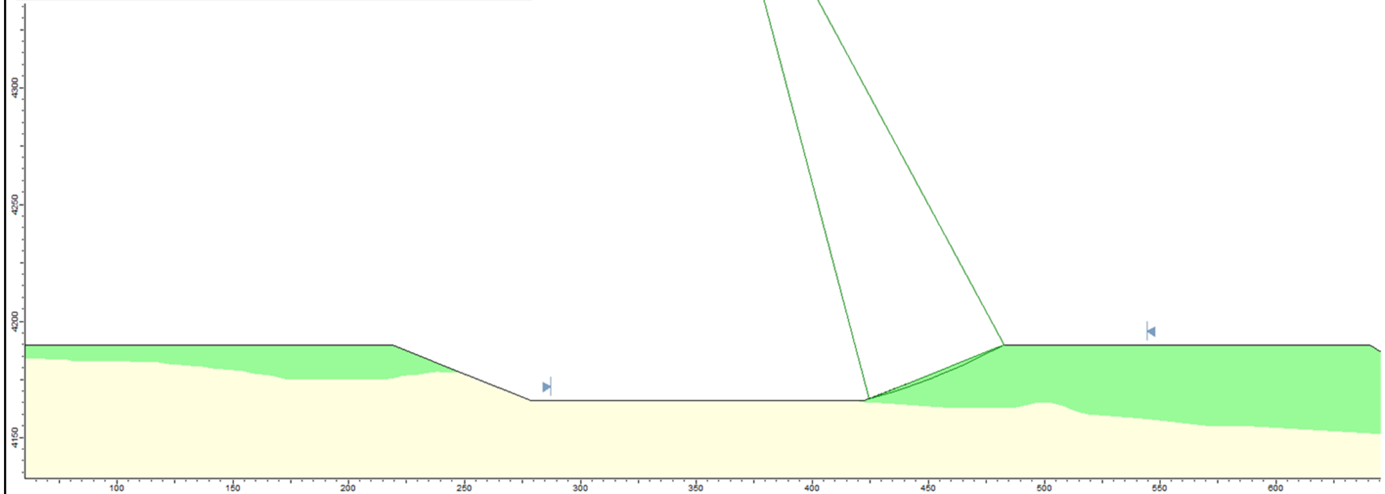


Figure A3. Location of cross sections S3 within Primary Settling Pond

Attachment 2: Stability Analysis

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses
Cross Section: S1
Location: Process Area Stormwater Pond

Analyses Scenario:
- Static Condition
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: West-East

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Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

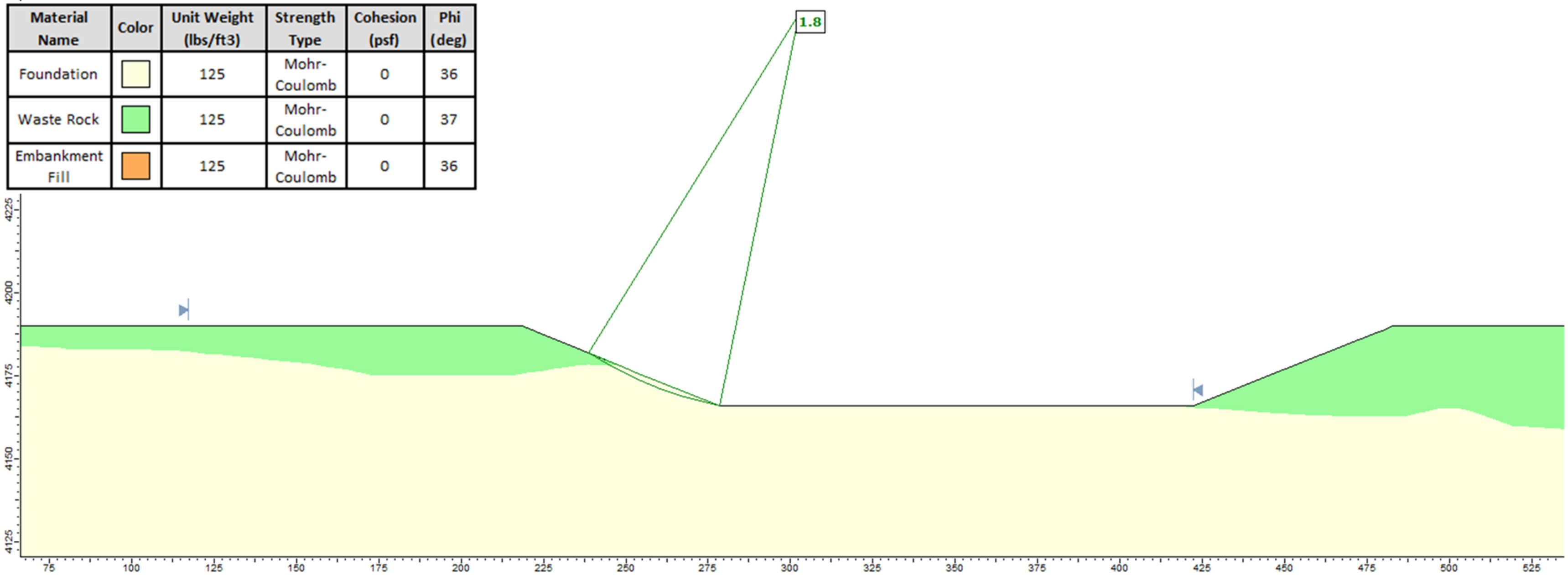
Figure B1

PROJECT NUMBER: 1720214024

REV. 0

RCC-CW004053

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses
Cross Section: S1
Location: Process Area Stormwater Pond

Analyses Scenario:
- Static Condition
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: East-West

Rosemont Copper World Project

Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B2

PROJECT NUMBER: 1720214024

REV. 0

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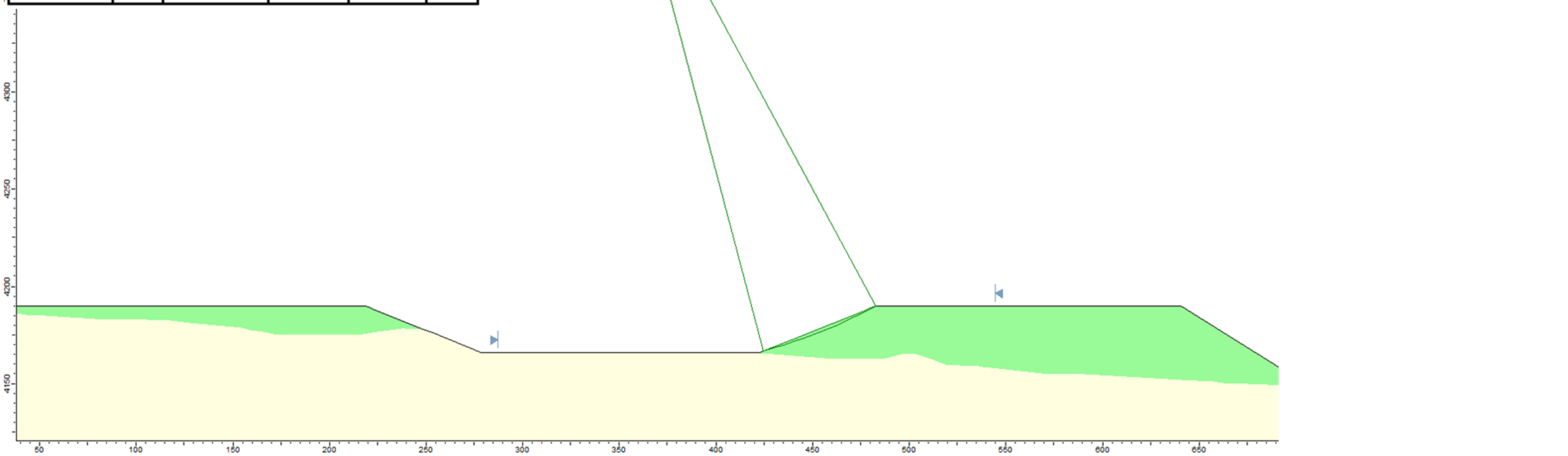
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses
Cross Section: S1
Location: Process Area Stormwater Pond

Analyses Scenario:
- Pseudo-Static Condition (K = 0.04)
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: West-East

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Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B3

PROJECT NUMBER: 1720214024

REV. 0

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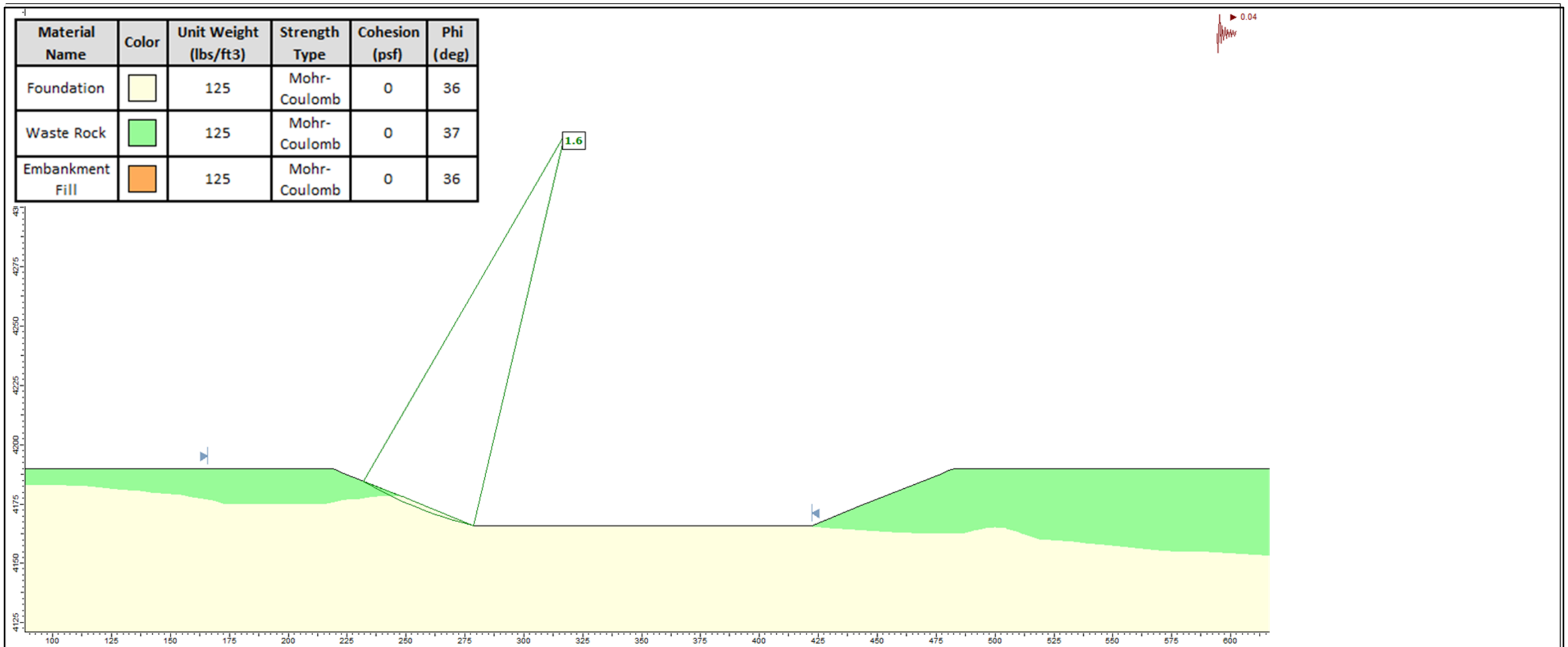
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses
Cross Section: S1
Location: Process Area Stormwater Pond

Analyses Scenario:
- Pseudo-Static Condition (K = 0.04)
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: East-West

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Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

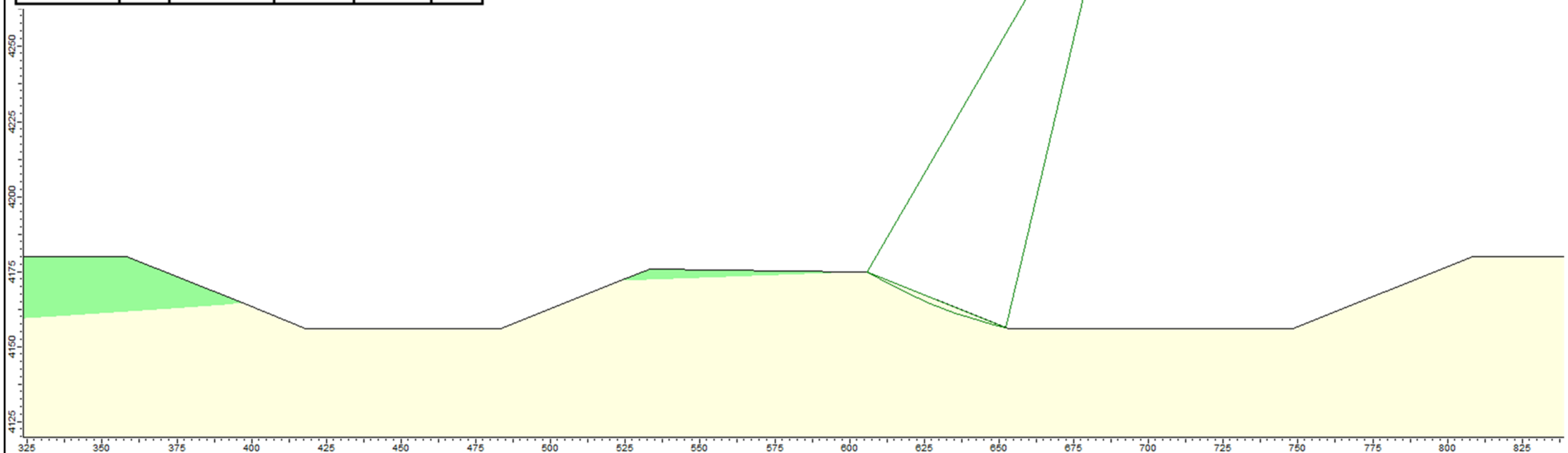
Figure B4

PROJECT NUMBER: 1720214024

REV. 0

RCC-CW004056

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses
Cross Section: S2
Location: Reclaim Pond

Analyses Scenario:
- Static Condition
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: West-East

wood.

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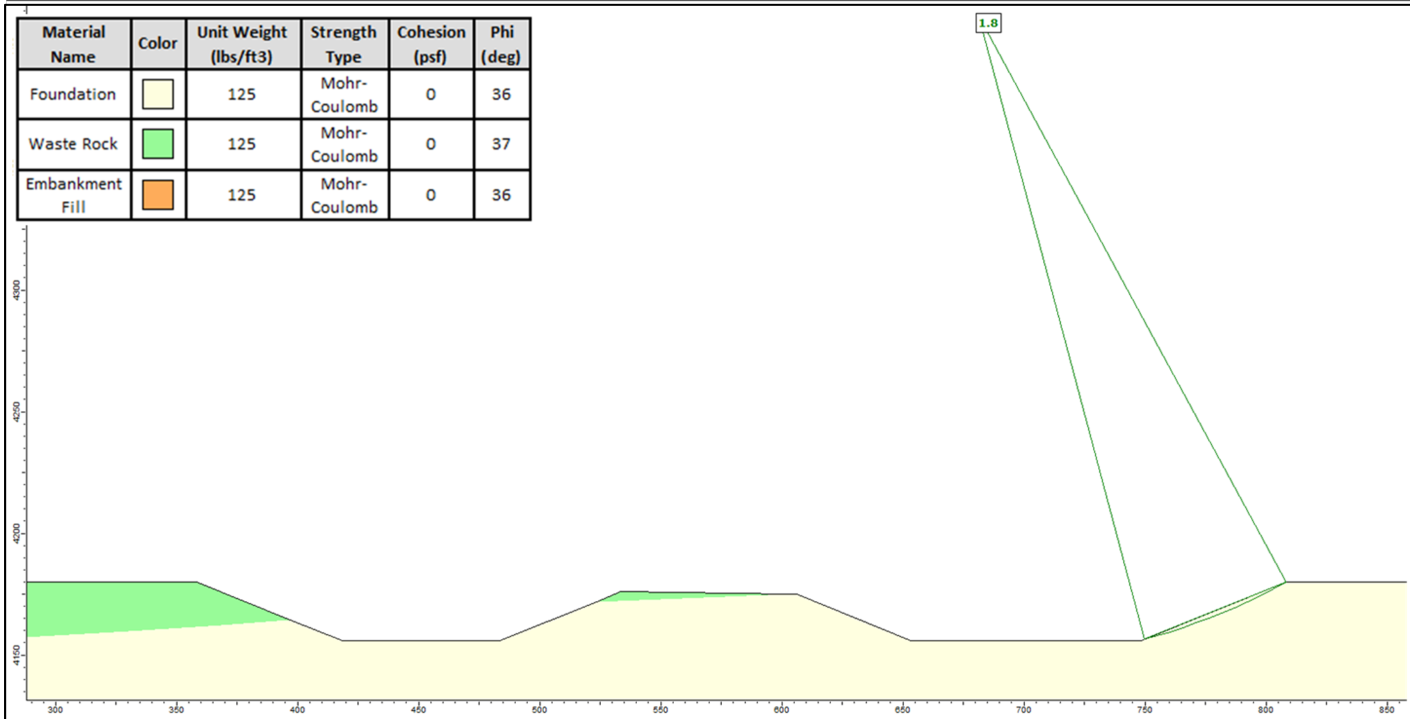
Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B5
PROJECT NUMBER: 1720214024
REV. 0

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses

Cross Section: S2

Location: Reclaim Pond

Analyses Scenario:

- Static Condition
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: East-West

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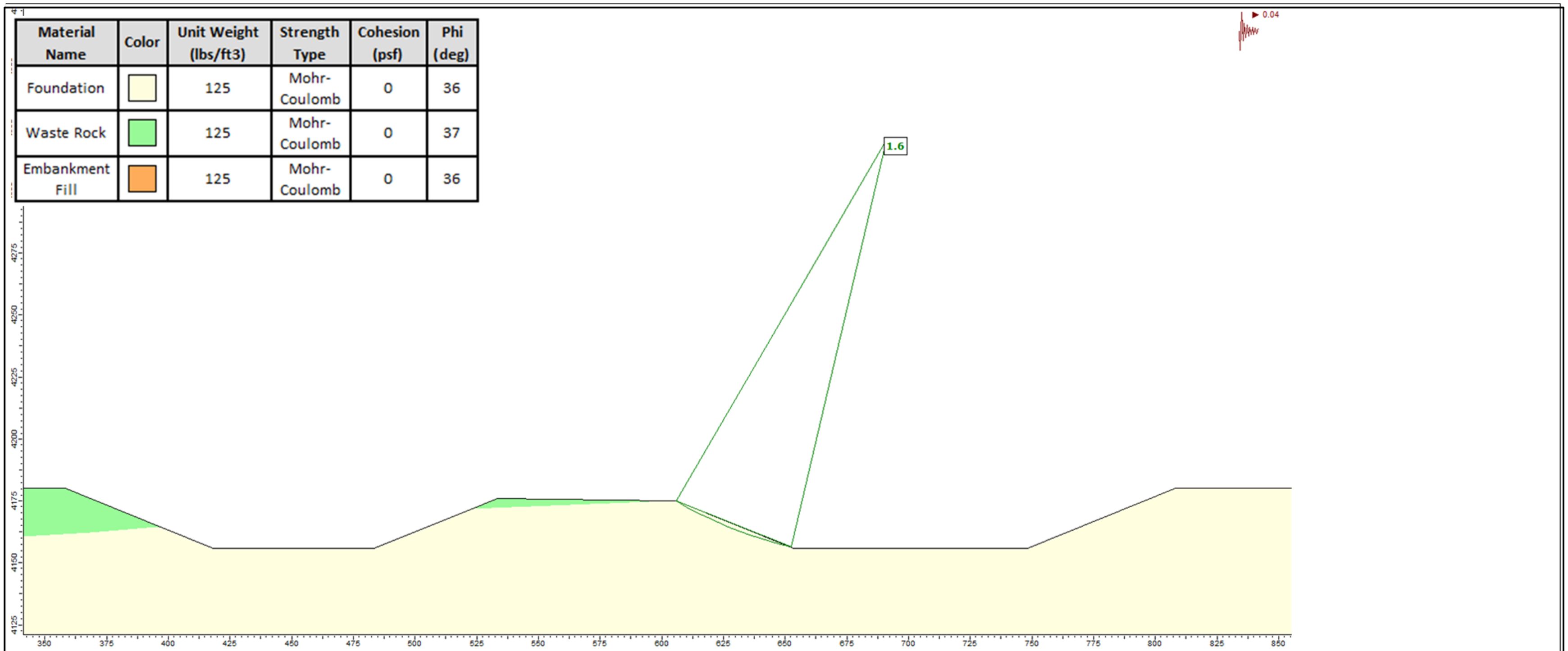
Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B6

PROJECT NUMBER: 1720214024

REV. 0

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses
Cross Section: S2
Location: Reclaim Pond

Analyses Scenario:
- Pseudo-Static Condition (K = 0.04)
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: West-East

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Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

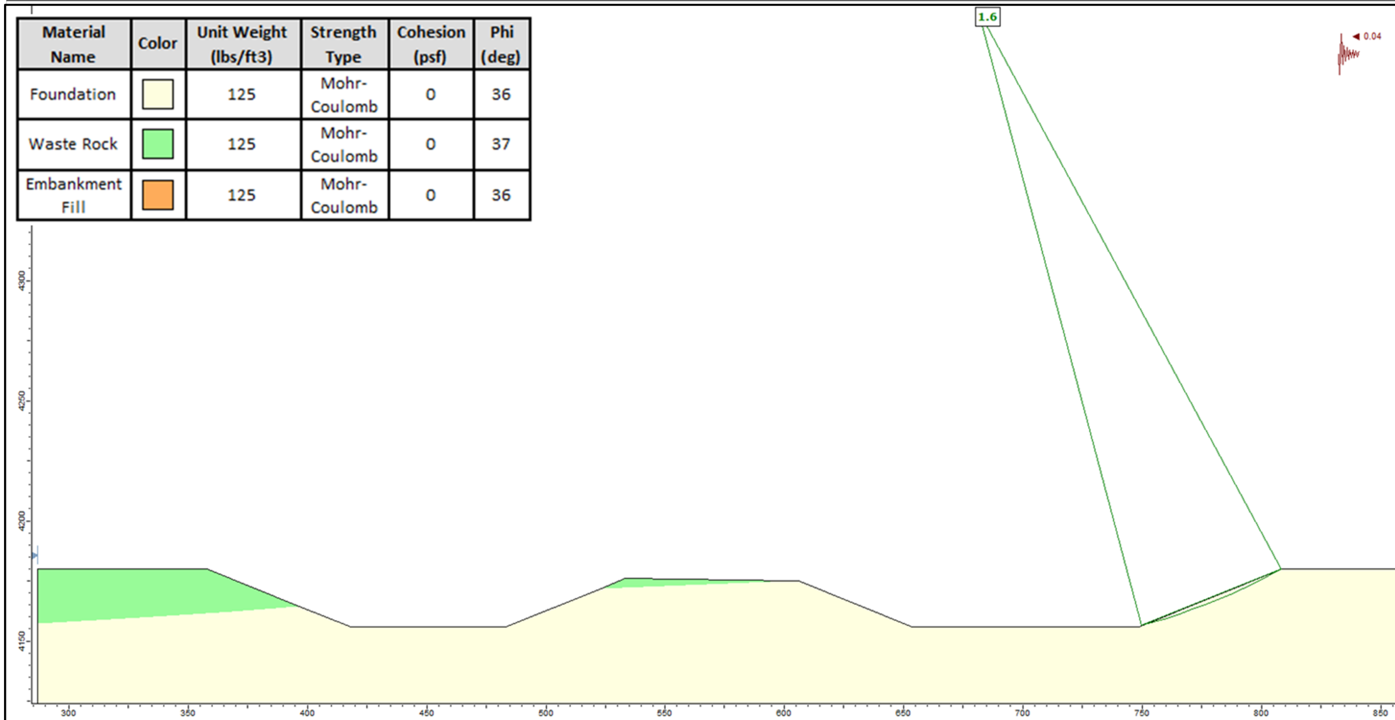
Figure B7

PROJECT NUMBER: 1720214024

REV. 0

RCC-CW004059

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses

Cross Section: S2

Location: Reclaim Pond

Analyses Scenario:

- Pseudo-Static Condition (K = 0.04)
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: East-West

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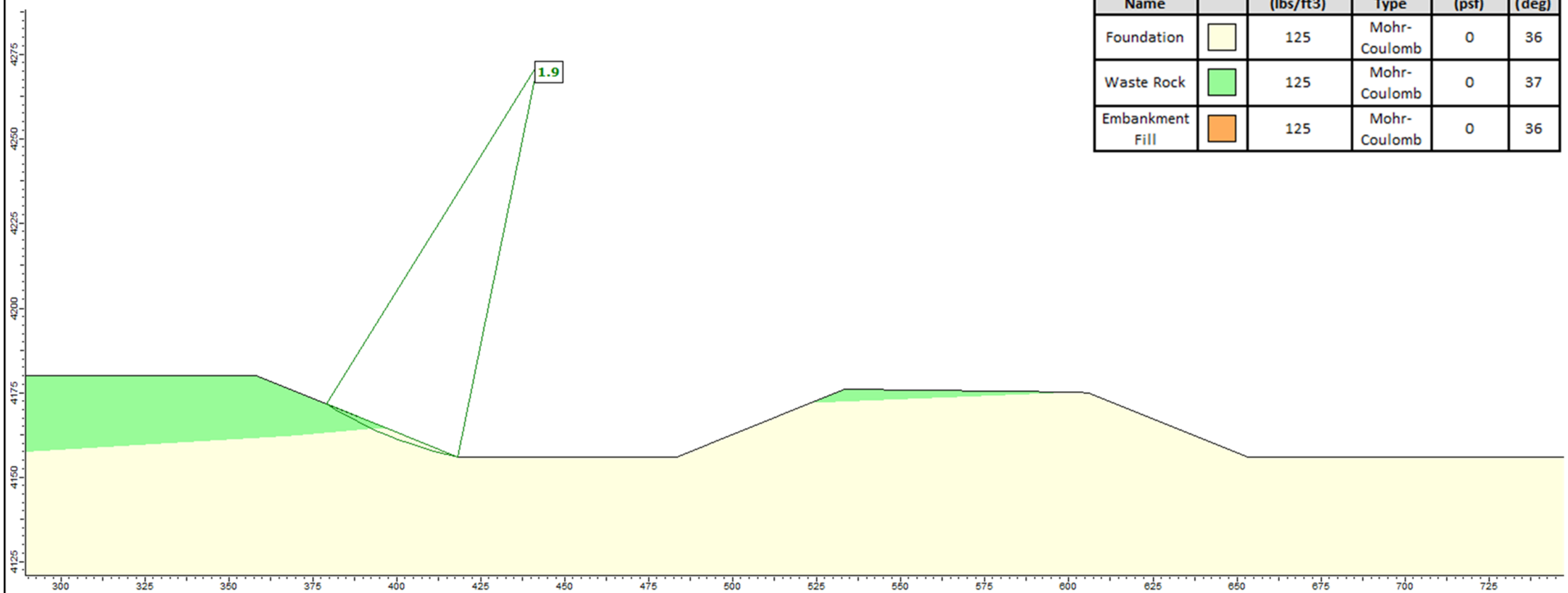
Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B8

PROJECT NUMBER: 1720214024

REV. 0

RCC-CW004060



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36

Stability Analyses

Cross Section: S2

Location: Raffinate Pond

Analyses Scenario:

- Static Condition
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: West-East

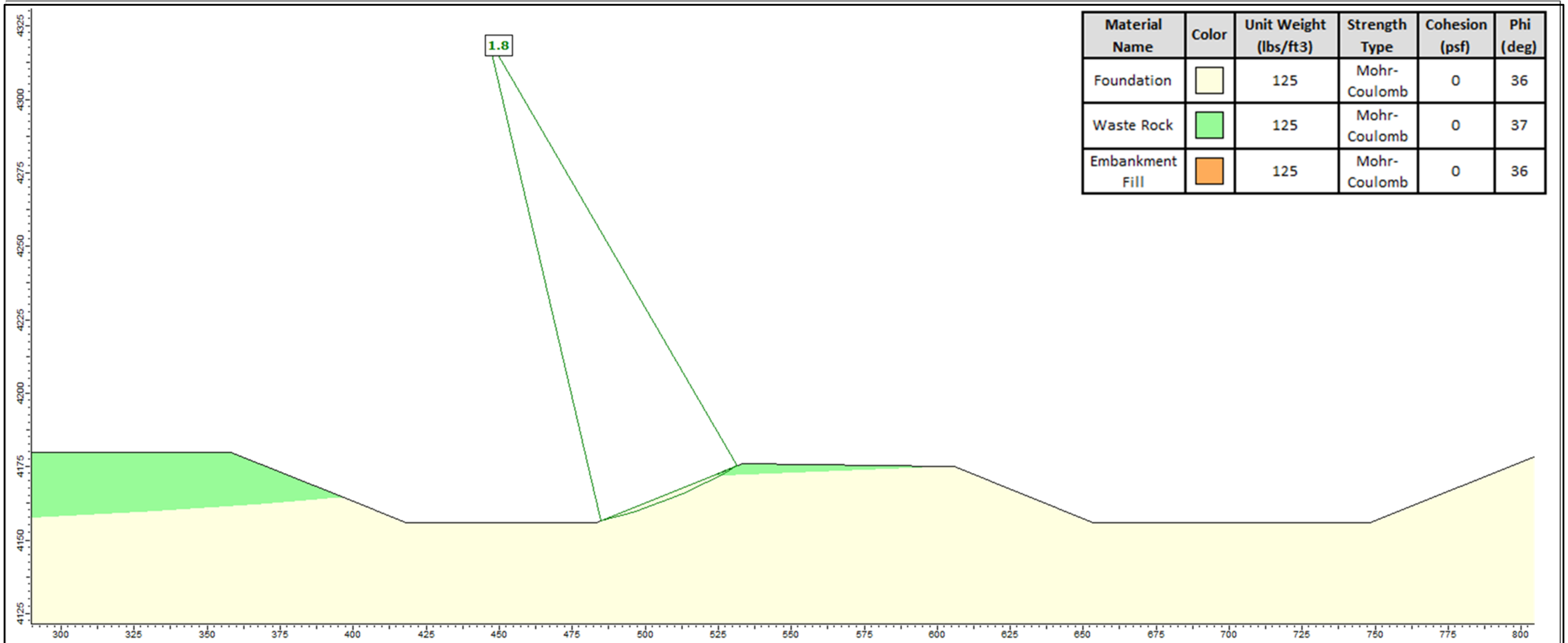
Rosemont Copper World Project

Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B9

PROJECT NUMBER: 1720214024

REV. 0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36

Stability Analyses
Cross Section: S2
Location: Raffinate Pond

Analyses Scenario:

- Static Condition
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: East-West

Rosemont Copper World Project

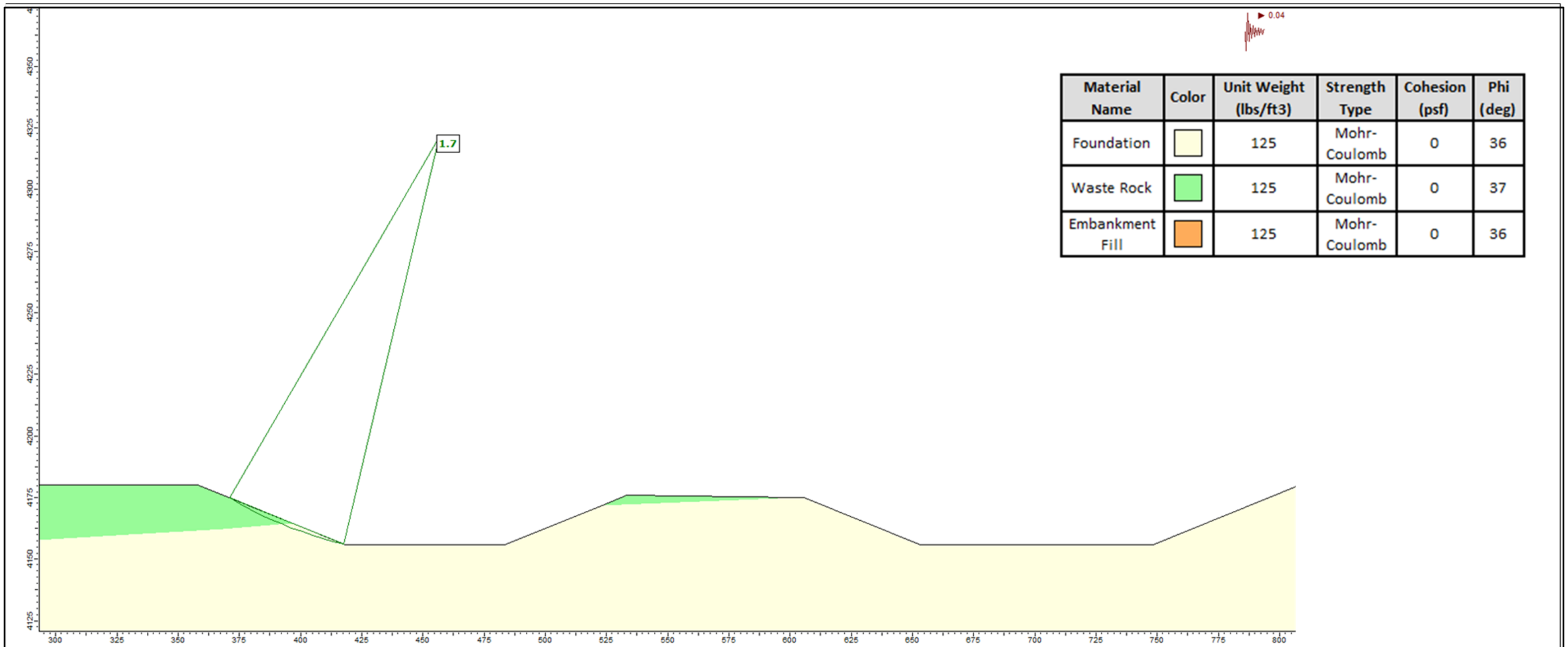
Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B10

PROJECT NUMBER: 1720214024

REV. 0

RCC-CW004062



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36

Stability Analyses
Cross Section: S2
Location: Raffinate Pond

Analyses Scenario:

- Pseudo-Static Condition (K = 0.04)
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: West-East

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Rosemont Copper World Project

Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B11
PROJECT NUMBER: 1720214024
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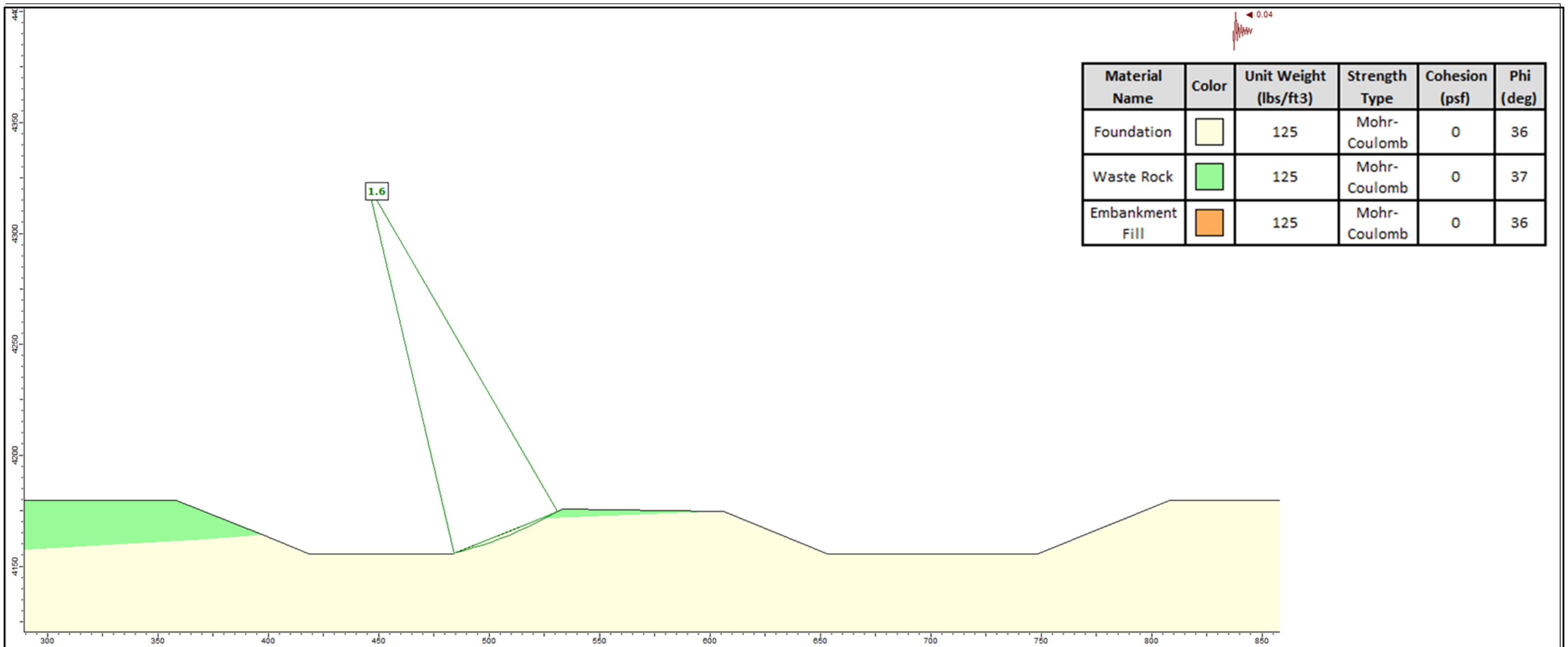


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36

Stability Analyses

Cross Section: S2

Location: Raffinate Pond

Analyses Scenario:

- Pseudo-Static Condition (K = 0.04)
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: East-West

Rosemont Copper World Project

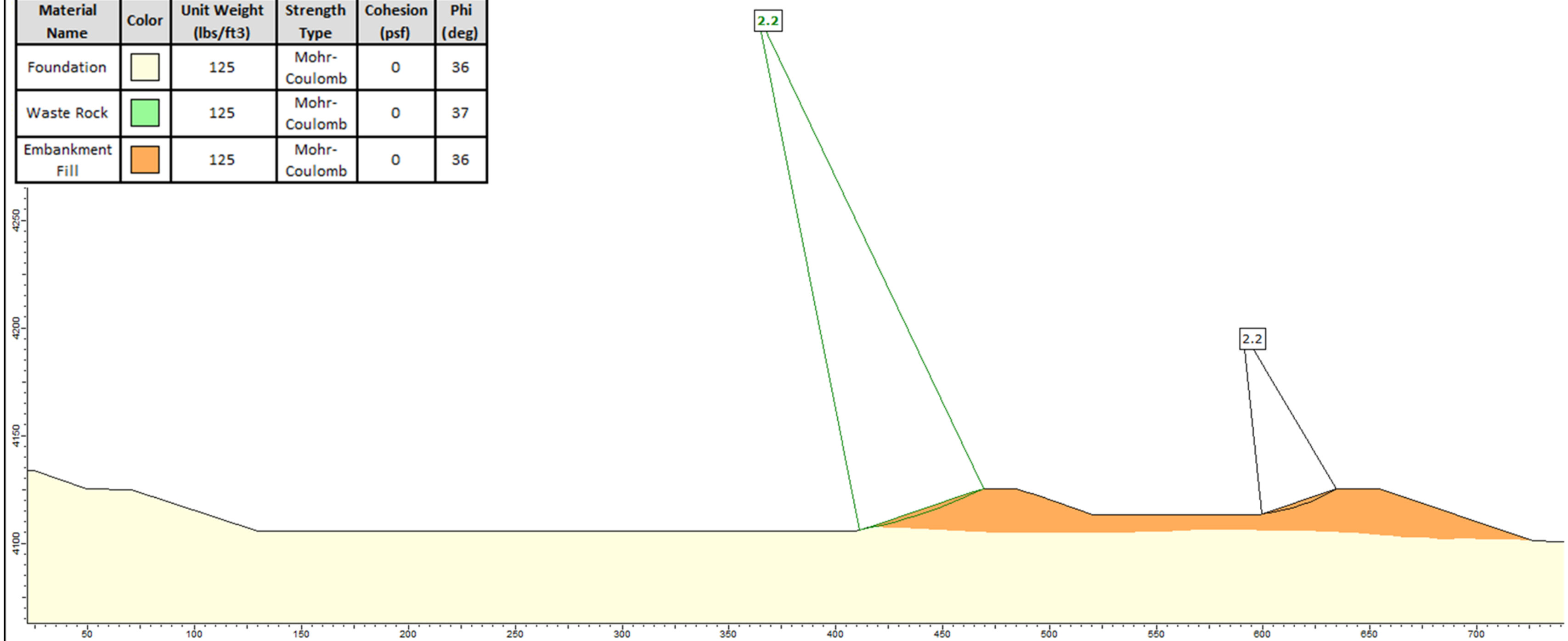
Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B12

PROJECT NUMBER: 1720214024

REV. 0

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses

Cross Section: S3

Location: Primary Settling Pond

Analyses Scenario:

- Static Condition
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: West-East

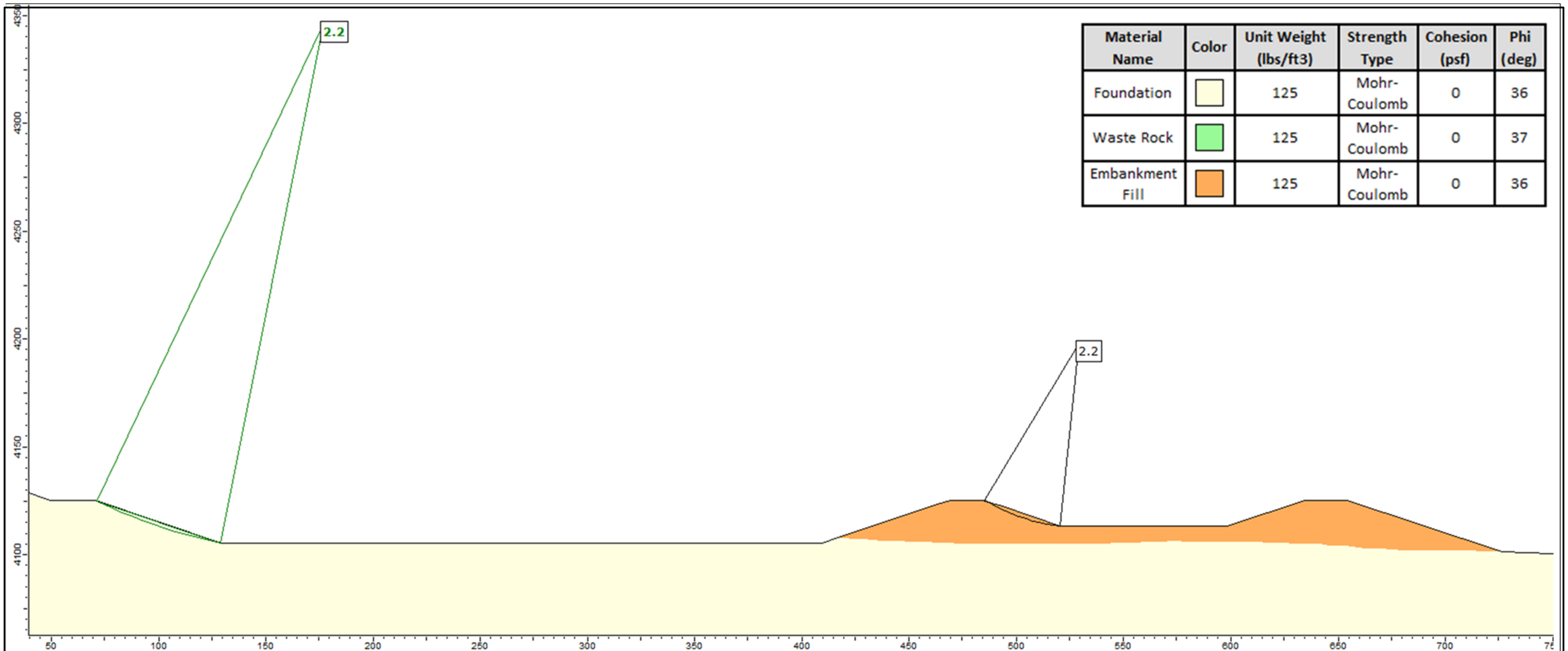
Rosemont Copper World Project

Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B13

PROJECT NUMBER: 1720214024

REV. 0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36

Stability Analyses
Cross Section: S3
Location: Primary Settling Pond

Analyses Scenario:
- Static Condition
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: East-West

Rosemont Copper World Project

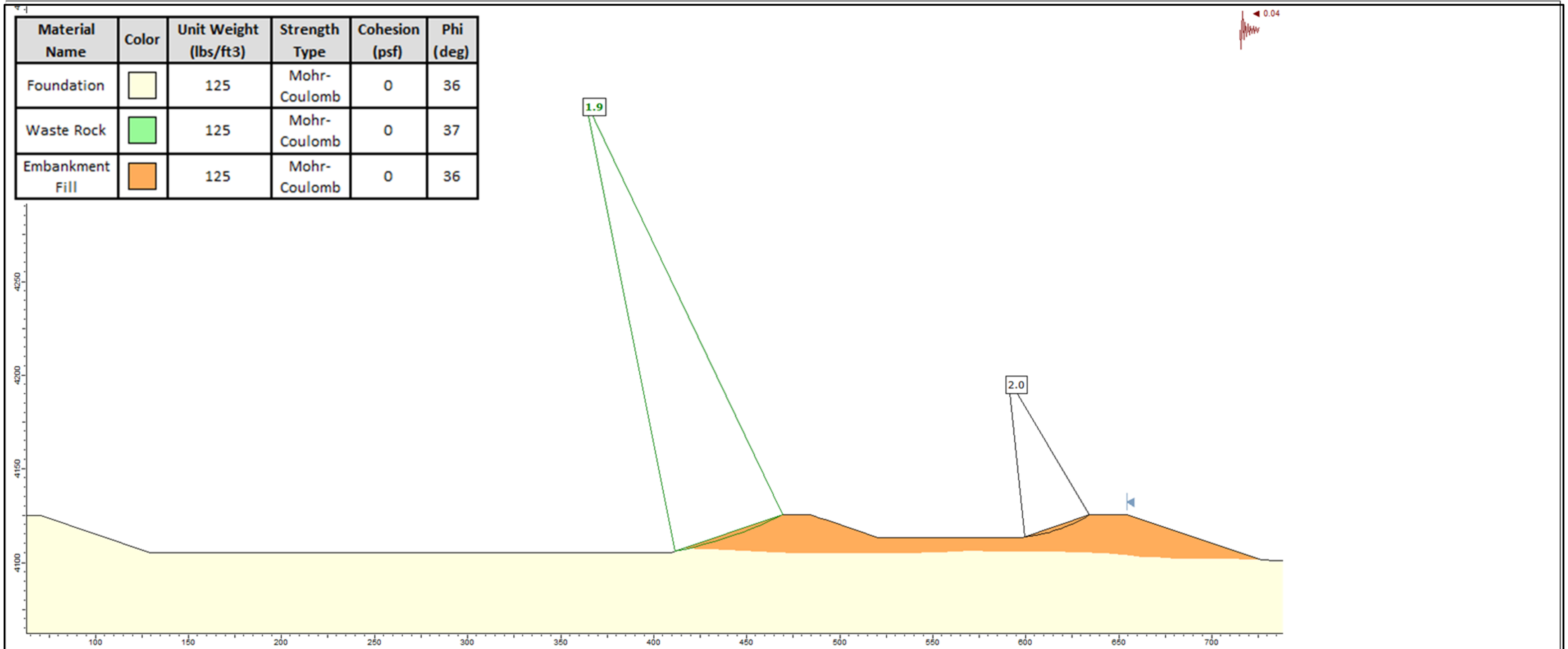
Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B14

PROJECT NUMBER: 1720214024

REV. 0

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36



Stability Analyses
Cross Section: S3
Location: Primary Settling Pond

Analyses Scenario:

- Pseudo-Static Condition (K = 0.04)
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: West-East

Rosemont Copper World Project

Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B15

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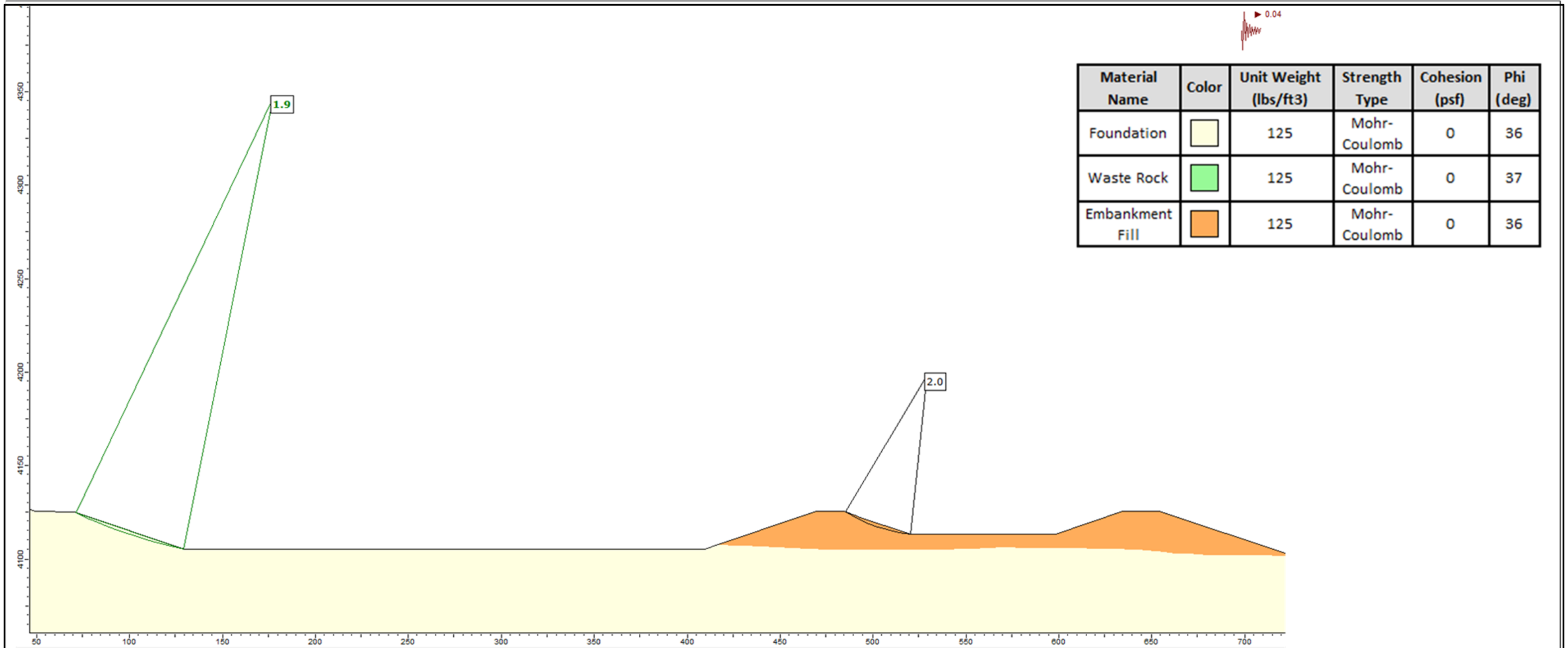

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Foundation		125	Mohr-Coulomb	0	36
Waste Rock		125	Mohr-Coulomb	0	37
Embankment Fill		125	Mohr-Coulomb	0	36

Stability Analyses
Cross Section: S3
Location: Primary Settling Pond

Analyses Scenario:
- Pseudo-Static Condition (K = 0.04)
- Drained Shear Behavior
- No Phreatic Surface
- Failure Direction: East-West

Rosemont Copper World Project

Stability Analyses on Primary Settling, Process Area Stormwater, Reclaim, and Raffinate Ponds

Figure B16

PROJECT NUMBER: 1720214024

REV. 0